Missouri Department of Natural Resources
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Strip Pit Management and Neutralization - Landowner Management Guide

Land Reclamation Program fact sheet 7/2003

Strip mine impoundments, or "strip pits," are important water resources for Missourians in the coal-mining regions of western and central Missouri. Most strip pits have sufficient water quality to support aquatic life including sport fish such as largemouth bass and channel catfish. Strip pits are also important resources for terrestrial wildlife and greatly add to a region's recreational opportunities. Minelands and strip pits act as land "sponges," holding water in reserve and prolonging the summer flow of streams draining the mined areas. In times of drought, strip pits and their outflow often provide water for livestock and wildlife, long after other ponds and creeks have run dry.

Strip Mining and the Creation of Strip Pits

Strip pits are created by mining operations to remove coal from deep within the earth. Coal may be found at varying depths beneath the ground's surface. Often layers of soil and unusable overburden materials lie on top of the coal and must be picked up and moved before the commodity can be mined. As with a moldboard plow, earth is moved from the pit to the side previously mined. The result is that waste material, called spoil, forms long continuous mounds of up-turned earth referred to as "dumps." The final mining cut may be left open, like a farmer's dead furrow. Often this final open cut fills with water and forms the strip pit.

Current surface mining operations are required by law to save topsoil separately from spoil. There are requirements for replacing these materials to "reclaim" the land. However, mining operations in the past usually did not include such reclamation procedures and often left spoil dumps as they were laid. The quality of the water in the final pit often depends on whether or not the pits were formed before or after land reclamation laws went into effect and if acid-forming materials are present near the pit.

Water Quality of Strip Pits Formed by Coal Mining

Classic studies on water quality indicate that run-off from a watershed reflects the geochemical make-up of the soils, geology and the living organisms present in the watershed. A watershed is an area from which water drains from the land into a river, stream or pond. Rainwater infiltrates the soil and rocks. Certain chemicals can be dissolved and transported by subsurface water flow until the water empties into a strip pit or stream. This is how the water quality of a strip pit reflects the soils and geology of its watershed.

The geology of a strip pit's watershed is a jumbled mess of upturned earth resulting from the mining process. The rocks that form the mixed overburden have various chemical compositions. Some rock layers are hard and relatively impervious to breakdown (called weathering). Other rocks that are rich in organic matter weather very quickly. It is these organic-rich rocks

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that cause the acidity associated with strip mining. Missouri is fortunate that most geologic strata of the coal mining overburden in the state tends not to be strongly acid-generating. However, in certain Missouri locations, some organic-rich rock layers do produce enough acidity to cause acid mine drainage, which may acidify strip pits.

Acid-forming rocks are a reflection of Missouri's ancient past. Great swamps covered much of western and central Missouri. As the plants and animals of these swamps died, they fell to the bottom of the swamp. The oxygen-poor organic layers accumulated as long as the swamp existed. Eventually the seas invaded the swamp and covered the organic layers with silt and sand. Under pressure and heat, the organic matter of the swamp underwent physical and chemical changes and became coal. Under the oxygen-poor conditions of the swamp, sulfur combined with iron to form iron pyrite, or fool's gold. Pyrite became an impurity in the coal and other related rock layers. When pyrite-rich rocks such as coal are brought to the surface by mining, the oxygen in the air, in combination with bacteria, changes the pyritic sulfur into sulfuric acid. Iron and other metals are dissolved in the acidic water, causing the red and yellow colors associated with acid mine drainage.

Managing Strip Pits for Fish Habitat

Strip pits tend to be deep, U-shaped impoundments with steep banks, little shallow water and few structures to attract fish. A few management techniques can greatly improve fish spawning habitat and cover, but detailed planning is necessary to prevent later problems.

Strip pits often do not have adequate cover to maintain high small fish and fry populations. Building brushpiles by placing bundles of Christmas trees, cedar trees or deciduous trees along the shorelines provides cover for small fish. This promotes population diversity by size and species.

One common practice to increase shallow water spawning areas is grading flat areas in the spoil piles and flooding the flattened areas. However, this can pose a threat to the water quality of the strip pit. Excessive run-off from disturbed areas can cause turbidity and sedimentation. Disturbance of mine spoils can expose acid-generating material, which can result in acidification of the strip pit. Extreme caution must be taken before any drastic disturbance of minelands is undertaken. **It is advisable to have a detailed soil sampling and testing program performed before any disturbance of the minespoils.** Soil tests should be analyzed for the presence of pyrite in the spoil. This is especially true for old, abandoned mines with barren spoil piles. Only a few laboratories will run pyritic sulfur tests. For further reclamation information, contact the Missouri Department of Natural Resources' Land Reclamation Program.

For more specific fisheries management practices, contact the Missouri Department of Conservation, Division of Fisheries.

Treating Acidic Water in Strip Pits

Landowners with acidic strip pits often wish to neutralize them with hopes of producing a permanent fishing hole. Unfortunately, this is usually **not successful**. As previously mentioned, the water quality of a strip pit is a reflection of the soils and geology of its watershed. Acid impoundments are the result of acid forming materials in the watershed. Since it is not practical to treat the watershed, a landowner wishing to maintain fish in an acid pond is faced with a long-term battle requiring constant monitoring and neutralization efforts.

A landowner wishing to determine if it is practical to try to neutralizing an acidic impoundment should follow the following procedures:

1. Test the acidity of the water using a "pH" test kit. Missouri waters normally have pH's ranging from 7.0 (neutral) to 9.0 (basic). A pH below 7.0 is considered "acidic." Dissolved metals may be high in these waters, and dissolved oxygen content may be low. Fish and other aquatic organisms will thrive in water with a pH of 6.5 to 9.5. Outside this range, fish reproductive success decreases, and distress and rates of death increase.

2. **If the pH is below 5.0, attempts to neutralize the pond are not recommended.**

If the pH is between 5.0 and 6.0 and you wish to raise pH:

1. Begin adding lime to the impoundment and thoroughly mix it into the pit with a boat and motor (a minimum of a 25 horsepower motor). Some form of agitation is necessary to adequately mix the ag lime and water to neutralize the pit. The goal is to raise the pH to 7.0. (Hydrated lime may be used but is extremely caustic and can rapidly raise the pH to over 8.0. Carefully follow all label directions before using hydrated lime.)
2. Test the water's pH at both ends of the pit to determine the rate of neutralization.
3. Stop adding neutralizing material when the pH reaches 7.0.

Monitoring water pH is very important during the neutralization procedure. If hydrated lime is used, it can quickly change a pit's pH from 5.5 to 8.5 in a matter of minutes. A sudden pH change can cause a fish kill. Hydrated lime is very caustic, immediately rinse if it spills on exposed skin or metal.

Over time, an acid impoundment may gradually become capable of supporting fish. It all depends upon the concentration of acidity being produced in the watershed. Eventually, all the pyrite will oxidize. It may take years or decades to do so. Disturbing pyrite-rich mine spoils may set this natural reclamation schedule back.

Keep in mind that a neutralized pit can suddenly reacidify. Any attempt to neutralize a pond is a gamble, with no guarantees of long-term success. You may fish a strip pit one day and come back the next to find fish distressed and dying.

For more information

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